

UNMANNED SYSTEMS

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The Australia Issue



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ASSOCIATION FOR UNMANNED
VEHICLE SYSTEMS INTERNATIONAL





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WEIGHT - 13 lbs (5.9 kg)



Australia's CSIRO gliders explore flood fallout. Photo courtesy Craig Macaulay, CSIRO.

Features



U.S. Army Chief Scientist Scott Fish at AUVSI's Unmanned Systems Program Review.



UAS fly at RxCADRE firefighting demo.

- 16** AUVSI's Unmanned Systems Program Review 2011
- 20** Hurricane Hunting With the Global Hawk
- 24** Regional Overview: Australia
- 28** New Video Game Sensor Takes Off in DIY Robotics Community

- 30** Empowering Warfighters With Smartphones and Tablets
- 32** Unmanned Aircraft Battle Flames and Smoke During RxCADRE 2011
- 35** Gliders Explore Flooding Impacts Off Australia's East Coast
- 38** MAGIC 2010: The Challenge
- 40** Where We've Been: RPMB

Association News

- 9** Executive Vice President Report
Access to Airspace ... It May Be Closer Than You Think

- 20** AUVSI Foundation
STEM Education, Robotics and the AUVSI Foundation

Departments

- 12** News Briefs
 - X-47B Carrier Demo
 - Blind Driver Challenge
 - Centaur Flies in Test
- 20** Company News/
New Products
 - SeaBotix Introduces Mini ROVs
 - Cobham Acquires Telerob
 - Camcopter Flies With New Wescam
- 42** Chapter News
 - Pathfinder Chapter
- 43** Calendar of Events

On the cover: A Royal Australian Air Force Heron, part of Australia's air arsenal in Afghanistan. Photo courtesy ADF. Story p. 24.

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- North Dakota State Colleges of Science
www.ndscs.edu
- Northland Community & Technical College
www.northlandcollege.edu
- Northwestern Michigan College
www.nmc.edu
- Ohio University/Avionics Engineering Center
www.ohio.edu/avionics
- Oklahoma State University
www.okstate.edu
- Oklahoma State University Multispectral Laboratories
www.okstate-uml.org
- Physical Science Laboratory — New Mexico State University
www.psl.nmsu.edu
- Raspet Flight Research Laboratory-Mississippi State University
- Swedish National Defence College
www.fhs.se
- Tallinn University of Technology, Department of Mechatronics
www.ttu.ee
- UND Center for Innovation Foundation
www.innovators.net
- University of Alabama in Huntsville
www.uah.edu
- University of Dayton Research Institute
www.udri.udayton.edu
- University of Maryland
ram.umd.edu
- University of Oklahoma
www.arcc.ou.edu
- University of Oklahoma College of Engineering
www.ou.edu/coe
- University of North Dakota — UAS Center
www.uasresearch.org
- Utah Center for Aeronautical Innovation & Design
www.utahaero.com
- Villanova University
engineering.villanova.edu/cendac



Today, technology companies face a hiring crisis. The talent pool of students skilled in STEM curriculum (science, technology, engineering and math) is shrinking as demand for these qualifications grow.

The AUVSI Foundation was established to focus on the future of the unmanned systems industry and to develop hands-on educational programs to attract and equip students for a career in robotics. You can help the AUVSI Foundation in a variety of ways.

VOLUNTEER, MENTOR, DONATE

Learn how you can support our student autonomous vehicle competitions, mentor K-12 students, and fund programs that will bring hands-on robotic activities to schools and youth groups across the country.

Visit www.auvsifoundation.org for more information or to make a donation online.

**The AUVSI Foundation is a 501(c)(3) non-profit, charitable organization. All donations are tax-deductible.*

AUVSI Foundation's Student Competitions

SAVE THE DATE

19th Annual Intelligent Ground Vehicle Competition (IGVC)

June 3-6, 2011

Oakland University
Rochester, MI

4th International RoboBoat Competition

June 9-12, 2011

Founders Inn & Spa
Virginia Beach, VA

9th Annual Student Unmanned Air Systems (SUAS) Competition

June 15-19, 2011

Webster Field
Patuxent River, MD

14th International RoboSub Competition

July 12-17, 2011

SSC Pacific TRANSDEC
San Diego, CA

21st Annual International Aerial Robotics Competition

August 2011

Grand Forks, ND



Spectators are welcome at all student competitions. If you would like more information, please visit www.auvsifoundation.org. To sponsor, please contact Wendy Siminski at siminski@auvsifoundation.org.

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Executive Vice President Report

Gretchen West



Access to Airspace ... It May Be Closer Than You Think

AUVSI applauds the Federal Aviation Administration for its recent approval of the Mesa County, Colo., Sheriff's Office application for a Certificate of Authorization (COA). This COA gives the Sheriff's Office the approval to fly their small Draganflyer X6 UAS anywhere in the county under some limited restrictions. This is the largest flight approval yet seen by the FAA for our community and is a very positive sign for the future.

The law enforcement community has shown growing interest in using UAS for a variety of applications. However a very small percentage of law enforcement agencies in the United States actually own and use air assets. Many small UAS are affordable, but due to lack of access to airspace, they haven't been a viable option ... until now.

Flying many small UAS under 400 feet (as approved in the Mesa County COA) poses very little threat and yields no conflict with manned aircraft operations. The decision by the FAA to grant their COA hopefully will generate additional interest from the law enforcement community and also foster expedient approvals for other Tier 1 systems by the FAA.

FAA Reauthorization Bills are Moving Forward

In early February, Rep. John Mica, R-Fla., chairman of the U.S. House Transportation and Infrastructure Committee, introduced the Federal Aviation Administration Reauthorization and Reform Act of 2011 (H.R. 658). The bill includes four sections on integrating unmanned aerial systems into the NAS. After repeated delays, AUVSI is pleased that Mica has stated his goal is to get the bill signed into law by the end of March.

Prior to the bill's introduction, AUVSI submitted several suggested technical changes to the draft House bill, many of which were included. Some of the provisions AUVSI lobbied to have included were:

- Set a deadline of 30 Sept., 2015 for integration of commercial UAS into the NAS
- Define small UAS as weighing 55 pounds or less
- Require a comprehensive integration plan within nine months after consultation with the UAS industry
- Require annual reports to Congress on UAS activities
- Issue guidance on expedited integration and expansion of "public" UAS within nine months
- Allow for creation of special rules for certain UAS. Within six months, the Secretary of Transportation would have to determine if certain UAS may operate safely in the NAS before 2015.

To see a copy of the bill, visit the Advocacy section of www.auvsi.org. AUVSI continues to work with the committee staff and members of Congress to ensure the bill includes an aggressive timeline for UAS integration into the NAS.

Fiscal Year 2012 Defense Budget

In mid-February, Rep. Howard P. "Buck" McKeon (R-Calif.), chairman of the House Armed Services Committee, held a hearing to discuss the fiscal year 2012 Defense Budget. McKeon had promised "rigorous oversight" of the Department of Defense's budget request and invited Secretary of Defense Robert Gates as one hearing witness. While there is concern over sweeping cuts in the defense budget, Gates emphasized the need for "high-demand assets, including UAVs," and he also urged for the purchase of "more advanced UAVs." Clearly there continues to be great need by our country's military for these important systems.

UAS integration into the NAS is a complex issue and our community stands by the message that our primary goal is to achieve accelerated but safe integration. We're seeing more advances in technology, stronger support from decision makers and better understanding from regulators. Because of this awareness and support, access to airspace may be closer than you think.

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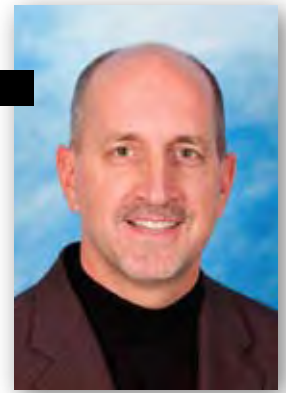


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Leading The Situational Awareness Revolution



STEM Education, Robotics and the AUVSI Foundation

Any industry involved in new technologies — especially technologies related to the defense industry — is usually mired in acronyms. One of the newest acronyms that you are likely to hear, if you haven't already, is STEM. STEM stands for "science, technology, engineering and math" and refers to four major areas of academic study. One reason STEM is such a hot topic is there has been a dramatic decline in the number of students who choose STEM-related educational tracks. This decline in students who are equipped and interested in pursuing technical careers comes during a time of unprecedented integration of technology into our everyday lives. Those divergent lines are a very real problem.

As a result, many world leaders are speaking out about the diminishing technical workforce and national programs and organizations are being created to address the fundamental, systemic problems embedded in this overall decline. Needless to say, this is a daunting challenge that will not be corrected quickly.

Recent research suggests that there is a significant drop off in students' interest in math and science around the late elementary school years. Experts attribute this drop off to the fact that teaching at that level typically becomes more theoretical and less hands on. An increasingly popular method for re-engaging students' interest in math and science at this critical stage is through robotics. Robotics is the perfect answer for a hands-on activity that addresses every element of STEM. And thanks to the popularity of toys like Lego and the proliferation of Lego's programmable robots, more and more students are being exposed to imagining, designing, building and programming — all of which support and encourage STEM learning. What better way to address a learning problem than to make the solution fun?

Which brings me to the role of the AUVSI Foundation and the part it plays in this broader context. Since 1991, when our first student competition was established, we've been increasing interest and participation in our events with the express purpose of attracting students into the professional community that AUVSI represents. The

competitions are intended to be a pipeline to draw students into the industry. To date, we've seen a good number of success stories that validate this mission. All throughout this industry, I see former students who competed in our competitions who are now working for AUVSI member companies or government organizations. But we can do much better.

Historically our competitions have attracted mostly collegiate participants, and we have learned that many of these students have already chosen career paths that are not in the unmanned systems industry. In my opinion, that's a function of us reaching them too late in their academic decision-making paths. To address this fundamental timing issue, we have been working to collaborate with robotic programs that reach students in the K-12 world. This is where we light the fire that will hopefully encourage students into a life-long career in robotics and unmanned systems. I was encouraged by a comment

from a Denver middle school teacher following last summer's Robo-Tour, in which her students and others were given the opportunity to visit the exhibit hall at AUVSI's Unmanned Systems North America. She said that in her 25 years of teaching, our event was the best she'd ever seen at inspiring students to continue on to college and pursue an education. It's only one comment, but it summarizes similar feedback I have heard from the teachers and parents we work with, and it suggests progress that we can expand upon.

To do that, we are asking for your help. If you too want to provide students with the opportunity to learn more about robotics, let's combine our efforts. We need mentors who are willing to donate their time and share their experience with kids in their communities. We need corporate support to help fund our educational outreach. There are countless ways we can work together, and we need the support of individuals and organizations to help us make these plans a reality.

If you or your organization would like to be a part of the AUVSI Foundation's efforts, please contact me at Davidson@auvsifoundation.org or call our office at +1 703 845 6978.

We need mentors who
are willing to donate
their time and share their
experience with kids in
their communities. We need
corporate support to help
fund our educational
outreach.

NEWS BRIEFS



The X-47B on its first flight out of Edwards Air Force Base in California. Photo courtesy Northrop Grumman.

X-47B Carrier Demo Aircraft Makes First Flight

Northrop Grumman's X-47B Unmanned Combat Air System Demonstration (UCAS-D) made its first flight on 4 Feb., taking off from Edwards Air Force Base, Calif., on a 29-minute flight that took it to 5,000 feet and may have ushered in a pending age of unmanned systems launched from aircraft carriers.

"First flight represents the compilation of numerous tests to validate the airworthiness of the aircraft and the robustness and reliability of the software that allows it to operate as an autonomous system and eventually have the ability to takeoff and land aboard an aircraft carrier," says Capt. Jaime Engdahl, the Navy's UCAS-D program manager.

In its first flight, the tailless UCAS-D, about the size of a manned fighter aircraft, flew several racetrack patterns and climbed to an altitude of 5,000 feet. The flight provided test data to verify and validate system software for guidance, navigation and the aerodynamic control of its design.

Engdahl said in a conference call with reporters on 5 Feb. that the flight comes almost exactly 100 years from the time an airplane first flew off a ship.

"Here we fast-forward 100 years, that we've added just three words: unmanned, autonomous, and LO [low observable] relevance to the puzzle," Engdahl said.

Before the first flight, the test team demonstrated airworthiness of the airframe through proof load testing, propulsion system reli-

ability through accelerated mission tests, software maturity and reliability through rigorous simulations, and overall system reliability through low-speed and high-speed taxi tests.

The X-47B aircraft will remain at Edwards Air Force Base for flight envelope expansion before moving to Naval Air Station Patuxent River, Md., later this year. There, the system will undergo additional tests to validate its readiness to begin testing in the maritime and carrier environment. Carrier trials for the X-47B are planned for 2013.

TORC, Virginia Tech Foster Blind Driver Challenge Technology

In February, the National Federation of the Blind, through technology created by TORC Technologies, of Blacksburg, Va., and Virginia Tech, enabled the first ever blind driver to navigate a car around the racetrack at Daytona International Speedway.

The NFB Blind Driver Challenge, which was part of the Rolex 24 Grand-Am race, was the brainchild of NFB, which released a call to all universities to assist the association with its goal. Virginia Tech and TORC Technologies, a Virginia Tech offshoot company that participated in DARPA's Urban Challenge, took up the task.

Using TORC's ByWire XGV research vehicle, similar to their vehicle from the Urban Challenge, Virginia Tech created haptic — or sensation-based — sensors feedback devices that fed information to Mark Riccobono, NFB's driver. Riccobono sat on one interface, SpeedStrip, which used vibrations up and down his legs and back to let him feel how fast to drive, reaching speeds

of up to 30 miles per hour. A second set of sensors, fingerless gloves called DriveGrip, sent vibrations along Riccobono's fingers to indicate where and how hard to make a turn. A soft right turn would send a vibration to Riccobono's right pointer finger, and a harder right turn would go across more of his right-hand fingers. Once the car was correctly oriented, the vibrations would stop.

During the challenge, Riccobono had to swerve around cones and barrels and also had to avoid boxes that were being thrown from a vehicle in front of the outfitted ByWire XGV TORC's Ford Escape. The 1.5-mile winding trip also had Riccobono pass the car throwing the boxes. He aced the course.

"Today I had the opportunity and responsibility to represent the thousands of members of the National Federation of the Blind, people who dream of new possibilities for their future, who seek greater independence," said Riccobono, who the day prior was able for the first time to take his wife and two of his children out for a drive.

UAV Caucus Renamed the Unmanned Systems Caucus

Reps. Howard P. "Buck" McKeon (R-Calif.) and Henry Cueller (D-Texas) announced that the former Unmanned Aerial Vehicle Caucus will now be called the Unmanned Systems Caucus.

Co-chairs of the caucus, McKeon and Cueller said in a statement that the goal of the caucus is to educate members of Congress, stakeholders and the public on the value of unmanned systems.

"I'm excited by the continued development and evolution of unmanned systems," said



Mark Riccobono of the National Federation of the Blind gets ready for the Blind Driver Challenge racecourse. Photo courtesy Steven Mackay, Virginia Tech.

McKeon, in the release. “The science and technology behind these systems are literally saving lives in civil and military communities. Our caucus is dedicated to educate and informing members of Congress, the private sector and the public about the importance and value of unmanned systems to the country.”

The caucus, which was formed in 2009, had grown to represent all three domains in unmanned systems. The name change is intended to reflect that, says the release.

“We have seen tremendous growth in the land, air and maritime sectors of the industry over the last two years,” McKeon continued.

“Unmanned systems have saved countless lives on the battlefield. I believe these systems and their capabilities go far beyond Department of Defense use, and I demonstrate continued success as they become more prevalent within our civilian communities,” McKeon added.

Cuellar, who became the new co-chair in late 2010, replaced ousted Rep. Alan Mollohan of West Virginia, who lost his bid for re-election.

“Unmanned systems are essential to further maintain security on our borders and to combat illegal activity at our ports of entry,” Cuellar said. “Their importance to our national security efforts cannot be overestimated, as they provide necessary information in moments of natural disasters at home as well as in the efforts to combat al-Qaida in

Afghanistan. We must do everything in our power to keep our communities safe and this caucus will help us reach that goal.”

As a member of the caucus in 2010, Cuellar was part of the movement to bring Texas its new border protection Predator UAVs.

“As AUVSI represents all unmanned systems domains — air, ground and maritime — we’re glad to see the caucus broadening its scope to encompass more of these important systems,” said AUVSI’s Gretchen West, executive vice president and vice president of government relations. “The unmanned systems community as a whole is growing and proving to be of extreme value for the defense, civil and commercial sectors, and the caucus’ expanded focus will bring greater prominence to our industry.”

Optionally Piloted Centaur Flies in Test

The optionally piloted Centaur aircraft — built by Manassas, Va.-based Aurora Flight Sciences and based on the Diamond DA42 NG general aviation aircraft — flew in its first flight test program in late January.

Named after a half-man, half-beast, Centaur was flown both with pilot Thomas Washington and in autonomous

mode over three days of testing in January.

“The first flight served mainly to validate that all the hardware and software were working as planned,” says Washington, who also served as test director. “Following a careful review of the data, we conducted a second flight on the 24th and a third flight on the 25th, during which all the basic UAV flight modes were turned on and carefully monitored. The initial results look fantastic.”

Eventually the tests will include unmanned takeoff and landing, a goal Aurora hopes will be reached by late spring. After that, Centaur will test its intelligence, surveillance and reconnaissance abilities with an electro-optical payload and a high-bandwidth data link.

Aurora is taking orders for the aircraft, with delivery slated for the latter half of the year.



The optionally manned Centaur aircraft successfully flew its first test flights in January. Photo courtesy Aurora Flight Sciences.



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COMPANY NEWS / NEW PRODUCTS



One of SeaBotix's new vectored mini-ROVs hits the drink in San Diego. Photo courtesy SeaBotix.

SeaBotix Introduces Vectored Mini ROVs

San Diego, Calif.-based SeaBotix is introducing two new remotely operated vehicles that the company says are the first mini-ROVs to offer true vectoring.

Both models share six brushless DC thrusters and vectored horizontal thrusters. The vLBV300 has a depth rating of 300 meters (1,000 feet), and the vLBV950 has a depth rating of 950 meters (3,117 feet). It has a 95mm propeller, which is optional on the vLBV300, which otherwise has a 76mm propeller.

Vectored vehicles started in the 50-kilogram (110-pound) weight range, SeaBotix says, but the vLBV300 is 18 kilograms (40 pounds) in air with 2 kilograms (4.4 pounds) of built-in ballast.

Cobham Acquires Robot Builder Telerob GmbH

Cobham has acquired Germany's Telerob GmbH, builder of the Telex robot and other bomb disposal and threat response systems, for 78 million euros (\$106 million USD).

Telerob has more than 700 systems deployed in 55 countries and is a market leader in Asia and the Middle East, Cobham says. The company plans to integrate its communications and sensor equipment into the Telerob robots, along with cameras built by another recent acquisition, RVision. Cobham says this combination will allow it to develop "more distinctive and competitive systems."

Telerob has a staff of 80, half of whom work

in research and development. The company will become part of Cobham's Mission Equipment business unit, which has more than 20 years' experience with unmanned systems, including the Phoenix aircraft.

Cobham has acquired two businesses in the U.S. and Europe worth a total of USD \$150 million in the past month, both serving homeland security markets, with complementary technologies and routes to market.

"Telerob brings distinctive explosive ordnance device technology and international routes to market that are highly complementary to ours," says Andy Stevens, Cobham's CEO. "This acquisition will enable us to enhance the product range we can offer to homeland security markets."



Two of Telerob's robots. Photo courtesy Cobham.

Singapore's UTC Buys Two ISE Manipulators

Underwater Technology Services (UTS) Singapore has purchased two ISE seven-function heavy duty manipulators and one five-function heavy duty manipulator from British

Columbia, Canada-based International Submarine Engineering (ISE) along with ISE's control system ACE for its new Remotely Operated Driller's Tool (RODT).

The RODT is a remotely operated vehicle designed for drill ship support. Each seven-function ISE Magnum manipulators comes with a proportional control pack for adjustable pressure and flow control, as well as rotating jaws. The five-function arm includes a larger jaw opening. All Magnums have a maximum lift capacity of 454 kilograms (1,000 pounds) and are rated to a depth of 3,000 meters (9,842 feet).

The RODT is the first ROV for the newly formed ROV division of UTS.

Adaptive Methods Launches Fishing Net Penetrator

Seeking an advantage that fish don't have, Adaptive Methods of Centreville, Va., announced its new fishing net penetrator, called Net Pen, which would allow an unmanned underwater vehicle to cut through nets and continue its mission.

The Net Pen comes in internal versions that can mount inside a nose cone and external ones for UUVs with larger protruding surfaces such as masts or snorkels. Adaptive Methods, which also develops advanced sensor systems, says it can "design, prototype, integrate, test and manufacture NET PEN to address virtually any production-UUV net-mitigation deficiency or to meet any new or developing program requirement."



To see a video of the system in action, scan this barcode with your smart phone.

Bluefin Aims at Gulf of Mexico AUV Sales

Bluefin Robotics Corp. of Quincy, Mass., says it has teamed with Harvey-Lynch to promote and sell Bluefin systems in the Gulf of Mexico region, including Texas, Louisiana, Alabama, Mississippi and Florida.

Harvey-Lynch, based in Stafford, Texas, sells undersea maritime equipment to support autonomous underwater vehicles, remotely operated vehicles and other systems.

"The agreement highlights the emergence and maturity of AUVs as a cost-effective and capable tool for use in a variety of subsea engineering projects," Bluefin says. The move comes on the heels of the company's two-year effort to expand its business domestically and internationally into the commercial survey market.

"The commercial AUV market is on the verge of significant further advancement and growth, and we believe Bluefin is at the head of the pack," says Phil Howells, president of Harvey-Lynch. "We are excited to be a part of it."

Elbit's MicroCoMPASS Ready for Shipboard Duty

Elbit Systems Electro-optics (Elop) says it has developed a unique hardware and software capability that allows its MicroCoMPASS electro-optical payload to connect with any maritime platform using plug-and-play technology.



Elbit Systems' new plug-and-play Micro CoMPASS payload.

The MicroCoMPASS payload is the newest member of the Haifa, Israel-based company's CoMPASS family of stabilized payloads. It includes a laser rangefinder, laser target illuminator, automatic video tracker, and a continuous-zoom infrared and daylight camera. The company is pitching it for coast and border protection, force protection, and search and rescue missions.

Elbit says its plug-and-play software allows for easy integration of the MicroCoMPASS with other systems on ships, using common protocols and an open architecture interface. The configuration does not require adjustments and doesn't interfere with existing systems, Elbit says.

"MicroCoMPASS will allow early detection and identification of potential threats, enabling quick and efficient threat neutralization and/or preventing terror attacks throughout the customer's maritime arena," the company says.



Schiebel's Camcopter, now flying with a Wescam MX-10 payload. Photo courtesy Schiebel.

Camcopter Flies With New Wescam Payload

Austria's Schiebel says its Camcopter S-100 unmanned helicopter has flown with a new Wescam MX-10 EO/IR payload, adding a new sensor capability to the platform.

"After just a few days of installation and integration activities of a joint L-3 Wescam-Schiebel team, the MX-10 flew successfully at a test range near the Schiebel production facility in Wiener Neustadt, Austria," the company says.

The MX-10 was controlled via a datalink and successfully transmitted live imagery to the ground control station.

"The Camcopter S-100 is generating a great deal of interest around the world, and we see the addition of the MX-10 as another high-performing payload for our customers to choose from," says Neil Hunter, Schiebel's sales director.

Lattice Tapped for Anti-IED Work

Lattice Government Services, a subsidiary of Lattice Inc., will develop a hardware/software interface for the U.S. Air Force intended to fuse data from various sensors to detect improvised explosive devices.

The remote controlled improvised explosive device (RCIED) has become a major weapon against coalition troops in Iraq and Afghanistan. Given its high success and effectiveness against coalition forces, as well as its low cost and ease of use, military experts and others believe this will be an

indefinite ongoing threat to U.S. forces.

"Up to 40 percent of all U.S. and coalition deaths in both Iraq and Afghanistan have been associated with improvised explosive devices," says Paul Burgess, CEO of Lattice. "In addition, the Department of Homeland Security reports that more than 600 IED incidents occur worldwide each month outside of these regions, including within the U.S."

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Maritime Day at AUVSI's Program Review 2011.

AUVSI's UNMANNED SYSTEMS **PROGRAM REVIEW 2011**

Interoperability and Common Controllers Reign Throughout Conference

By Brett Davis and Danielle Lucey

AUVSI's Unmanned Systems Program Review 2011, a look at the new programs and applications in air, ground and maritime unmanned systems domains, brought almost 800 people from an array of communities to focus on the next state-of-the-art requirements in robotics and unmanned systems.

While separated into dedicated air, ground and maritime days, emerging across-the-board themes such as cost control, open architecture and increased power capabilities showed that unmanned systems from all domains are still seeking new and innovative ways to advance the technology.

Common Controls Touted By All Domains

Jim Lasswell, the technical director for the U.S. Marine Corps, said ease of use is critical for Marine Corps. If the corps thinks a system requires too much training or maintenance, it won't use it, a fate that has befallen at least two ground robotic systems.

"We need to make it something that the infantry man on the ground can use with ease," Lasswell said.

His service is pursuing one Holy Grail of advanced technology, the common controller, in the form of the Tactical Network Sensor Systems (TNS2). This would allow a Marine to "control all the gear that he comes in contact with," including ground vehicles, air vehicles and unattended sensors.

Jim Overholt, the Army's chief roboticist, echoed the need for a common controller after showing a busy slide displaying all the current controllers. "Boy, do we really need to standardize in this area," he said.

He also cited a commercial product — automatic windows in automobiles — as a way to challenge robot builders. Power windows, when first introduced in the 1970s, would fail in a matter of months. Now they last for years.

"Why not have robots approach automotive levels of reliability?" he asked. "It's a lofty goal, it's a goal that's way out there but it's a goal we really have to embrace."

Rear Adm. Matthew Klunder, director of the intelligence, surveillance and reconnaissance capabilities division at OPNAV N2/N6F2, drove home the concept of commonality, likening the U.S. Navy's need for a common controller to Apple's iPhone. To remain in competition in the Navy's tight budget, industry will have to build software, like the iPhone's apps, to remain relevant, he said.

Tim Owings, deputy program manager for the Unmanned Aircraft Systems Program Executive Office in the U.S. Army, said the Army is seeking to demonstrate live the uses of a common controller through the Manned Unmanned Systems Integration Capability Exercise, or MUSIC, set to take place at Dugway Proving Grounds in Utah in September.



James Overholt.



Zach Lemnios.



Byron Brezina.

“You’re going to see everything the Army flies from an unmanned perspective operating with each other” through a common ground control station, he said. The Army plans on holding MUSIC every other year to continue to advance the state of the art, he continued.

Commonality Brings Competition

The acquisition program Advanced Explosive Ordnance Disposal Robotic System, or AEODRS, which received Milestone B approval in December, looks to use a family of unmanned ground vehicles that can be used by joint explosive ordnance disposal forces for IED and unexploded ordnance threats using a common control unit.

The program promotes future technology infusion in a truly competitive environment, said Byron Brezina, technical project manager for the Robotic Systems Joint Project Office.

“Anybody now can come to the table and say, look, I’ve got a better module,” said Brezina. The program is looking for competition, he added, instead of the typical sole-source contracting environment.

“We’re not pushing the bar too much on the actual technology,” he said. “Really what we’re doing new here is the architecture.”

The program will be in production from 2015 to 2019, Brezina said.

Ground Robotics Looks for Rapid Fielding

Ground robotic systems need to be more autonomous, more perceptive and more reliable, but they don’t necessarily have to achieve all those things at once, said speakers at the opening day of AUVSI’s Unmanned Systems Program Review 2011.

Zach Lemnios, the assistant secretary of defense for research and development, said the Department of Defense is “investing in concepts to prepare for an uncertain future.” Two decades ago, that included technologies like GPS and stealth. Now it includes quantum computing, synthetic biology and advanced modeling.

However, his office is also seeking ways to get technology into the hands of the warfighter more rapidly. “It’s about getting the 80 percent solution into the field now, rather than the 100 percent solution five years from now,” he said.

Scott Fish, the U.S. Army’s new chief scientist, said that a decade ago the service believed that the deployed of autonomous ground systems

was just around the corner, a belief that intensified in recent years but hasn’t quite come true.

“Though demonstrations abound, no significant autonomy is being used in theater,” he said. The Army needs to show a “real cost benefit” to deploying autonomous systems, and maybe some of the missions conceived for it may not be good fits after all, he said.

Access to Airspace Remains a Challenge

The second day of the conference, Air Day, found speakers from all backgrounds focusing on the struggles to fly unmanned aerial systems in the National Airspace System.

Montana State Sen. Ryan K. Zinke described his state’s ample airspace — about three-quarters the size of the state of Florida — that could be used for UAS training if the Federal Aviation Administration granted it access.

The FAA’s reauthorization bill, currently working its way through Congress, is “dead” from the Republican caucus’ point of view, he said.

“It’s not the UAS section that gives trouble, it’s what’s included in the rest of the sections, in who’s going to pay for what,” Zinke said.

Despite that, Zinke said he thinks designating test and development sites for multiple tiers of UAS is possible.

“What I see more on the political side is probably a continuation of incrementally going forward with the national airspace,” he said.

Brenda Mulac, UAS program manager for NASA’s Airborne Science Program, showed a different side of the certificate of authorization equation when discussing NASA’s recent research initiatives using UAS.

For the Global Hawk Pacific, or GloPac, Arctic research mission, “We had a COA that basically covered the entire Pacific,” where the U.S. maintains control, “as well as the Arctic,” she said. Mulac, who said that NASA waits in the same COA line as everyone else, said having a NASA/FAA liaison aided the process.

Capt. Gregory M. Maguire, of the chief concepts division of the Joint Unmanned Aircraft System Center of Excellence, said that even from inside of the Department of Defense, airspace is a big issue. JUAS COE has done an annual report on the national airspace. For this May’s report, they’ve done work with Nellis Air Force Base to look



Rear Adm. Matthew Klunder.

at lost link procedures so, instead of every service coming up with their own, one could be created through the DOD.

They are also working on a national airspace concept of operations in a report currently under review. He expects results in a couple of months and then will create a "capabilities-based assessment."

Interoperability With UCLASS

The Navy's unmanned carrier-launched airborne surveillance and strike (UCLASS) program will include significant cooperation with the U.S. Air Force and could one day serve as a wingman to manned aircraft, according to Rear Adm. Klunder.

The program will draw on lessons learned from the Unmanned Combat Air Systems Demonstrator (UCAS-D), which was once part of a joint program before the Navy continued it alone.

The Navy's Klunder said at Program Review's Maritime Day that the Navy and Air Force have signed a memorandum of agreement on UCLASS pledging to look for synergies where possible. As the Navy begins to fly UCAS-D and prepares for UCLASS, the Air Force is working toward the follow-on to the MQ-9 Reaper.

The Navy had planned to release a request for proposals for UCLASS this spring but that's likely to be pushed back, he said. However, the Navy is pressing ahead and has high hopes for the vehicle's future capabilities. Asked if a UCLASS could fly alongside, and interoperate with, a manned aircraft, he said, "absolutely."

"We are indeed building the design of the UCLASS to have the network standards and data links that would allow that, and potentially if those data links are working, you could even envision that someone flying this one [an F-35] might be controlling that one [a UCLASS] together."

U.S. Navy Prioritizes UUVs

The Navy is continuing to press ahead on its unmanned underwater systems, said Rear Adm. David W. Titley, oceanographer and navigator of the Navy. Since 1990, when its autonomous underwater efforts largely began, to 2010, the Navy has racked up 72,000 nautical miles and 85,000 hours with its vehicles.

"This is real. While we don't have power on these, we do have endurance on these gliders," he said. "These gliders are going for four- to six-month missions out of area. They are not just deployed around the United States," but have conducted missions in the Arctic, the Indian Ocean and the western Pacific. "These data are being used every day," he said, and "that is giving our forces an advantage today."

Integrating that autonomous underwater capability to the fleet is "exactly what I think we need to do," he said, although cost remains a key concern.



Tim Owings and Lt. Col. James Cutting.



Brenda Mulac.



James Galambos.



Ryan K. Zinke. All photos by AUUSI.

As the Navy moves to a large displacement UUV capable of endurance greater than 60 days, power and reliability are challenges. The need for autonomy also increases as the Navy seeks to operate in GPS-denied areas, said Capt. Duane Ashton, program manager for the Navy's PMS 406.

Large Diameter UUVs

In addition to the Navy's typical arsenal of unmanned underwater vehicles, under the Office of Naval Research sponsorship, Pennsylvania State University has continued its history of UUV development with its Large-Diameter UUVs, or LDUUVs.

In the last three years, with the aid of DARPA, the university has created both the Sea Stalker and the Sea Maverick LDUUVs.

The systems range in diameter from 36 to 48 inches, said James Galambos, associate director at PSU's Advanced Technology Office at its Applied Research Laboratory.

Like typical UUVs, power is an issue with this larger class of underwater vehicles. Galambos likened the LDUUV's power struggles due to complex behavior like the difference between city and highway driving in a car. The system is clearly power constrained, he said. A key to the technology will be "developing a really good power simulation capability so that you can include this complex behavior." The school's Sea Lion ONR UUV runs on lithium-ion batteries.

AUVSI's Program Review 2012 is scheduled for 7-9 February at the Omni Shoreham hotel in Washington, D.C.

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Into the Eye of the Storm: Hurricane Hunting With the Global Hawk

By Clark Perry

Having proven itself in theaters such as Iraq and Afghanistan, Northrop Grumman's Global Hawk has a strong reputation of flying the unfriendly skies. Last year the versatile unmanned aircraft was pressed into service on a mission whose potential dangers were unlike any other — flying directly into the heart of a hurricane.

NASA's Genesis and Rapid Intensification Process (GRIP) mission was designed to study the creation and rapid intensification of hurricanes. With the National Oceanic and Atmospheric Administration estimating the financial impact of 2005's Hurricane Katrina at \$120 billion, the costliest natural disaster in U.S. history, it's clear that any effort to understand and predict the paths of these storms can save lives and money.

GRIP was a multi-aircraft program conducted jointly with other agencies to study a series of tropical depressions and hurricanes during the 2010 storm season. All but one of these aircraft had previously proven their mettle in such turbulent weather. For the Global Hawk, this would be another test for the retrofitted military system.

In 2007, a \$25 million, five-year partnership between NASA and Northrop Grumman provided two early Global Hawk systems for scientific studies. NASA built an infrastructure to support the craft at its Dryden Flight Research Center housed at Edwards Air Force Base in California.

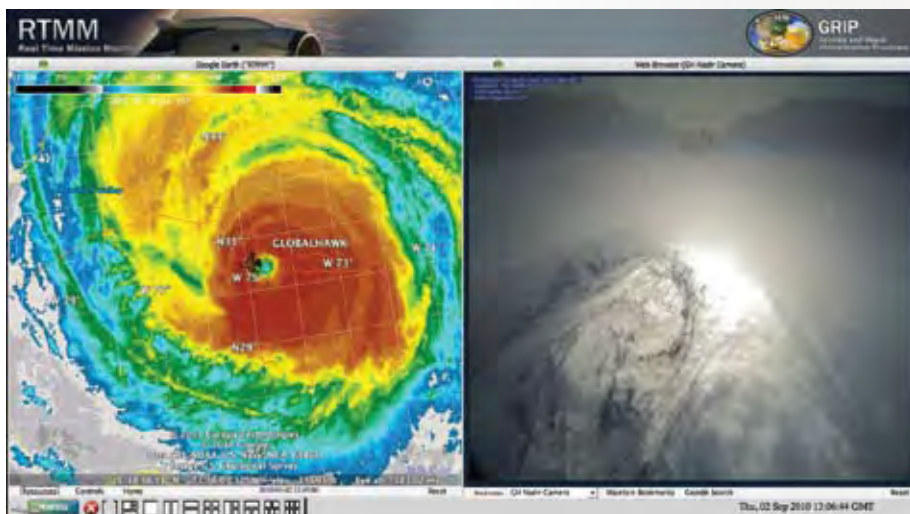
Since then, the Global Hawk has proved its adaptability in programs such as the Global Hawk Pacific, or GloPac, an ongoing mission to study atmospheric science over the Pacific and Arctic oceans (for more information, see the June 2010 issue of *Unmanned Systems*).

For GRIP, the Global Hawk carried a payload of 15 scientific instruments and flew in concert with NASA's converted DC-8 flying laboratory and a high-altitude WB-57.

The three aircraft flew coordinated missions that penetrated the heart of a series of developing storm systems, including several tropical storms and major hurricanes Earl and Karl, the latter proving to be the most destructive hurricane of the 2010 season. The aircraft also validated observations from space-based satellites during their data-collecting flights.



Nose of the Global Hawk in the early morning sun. All images courtesy Dryden Flight Research Center.



The flight track from NASA's unmanned Global Hawk aircraft as it made its first crossing through Hurricane Earl's eye on 2 Sept., 2010. Also a view from the nadir-staring camera from the belly of the Global Hawk.

Global Hawk allowed scientists to study storms for durations of up to 20 hours, something that's never been done before. The concern of payload manager David J. Fratello was first and foremost the safety of the aircraft. During the GloPac environmental study program, the UAV's experiments included vertical profiling — gathering data at various altitudes from the equator to the Arctic. Fratello and his team realized early on that vertical profiling in hurricane-force winds would be disastrous.

"The Global Hawks are not designed to fly anywhere near convection or moderate turbulence," says Fratello. "We added some instrumentation on the plane to give our pilots as much real-time information as possible on the weather."

Assuring the safety of the Global Hawk was a step-by-step process. "Our only promise to the science community was that we would tiptoe our way in, as long as we felt there was no risk to the aircraft. We knew we were high up and there's much less turbulence at those altitudes," says Fratello.

Additions to the Global Hawk included a daytime/nighttime camera to view cloud tops and a storm scope to monitor lightning. In addition, ground control monitored all real-time weather satellite data from NASA. "Those things really worked out because our pilots had confidence that the weather over these storms was indeed calm and essentially convection free," says Fratello.

While the DC-8 and WB-57 collected data at lower altitudes, the Global Hawk flew above them at 60,000 feet for each of GRIP's five missions.

Coordinating all three aircraft over one storm system was a logistical challenge. The DC-8 flew out of Fort Lauderdale-Hollywood International Airport in Florida, and the WB-57 was based out of NASA Johnson Space Center's Ellington Field in Houston. The Global Hawk flew out of Edwards Air Force Base and logged more than 120 hours of total flight time during GRIP.

The Global Hawk's ability to fly in the stratosphere contributes to its long range, even though it's not the fastest plane in the bunch. "We had multiple passes over the hurricane eye and outer wall," says Fratello. "Coordinating the aircraft is a little challenging because the DC-8 flies faster than we do, but the pilots did a great job."

On another flight, the Global Hawk and other aircraft began tracking a tropical depression near Haiti, which rapidly grew into

Hurricane Karl. "When we got there, it had just that night grown from a tropical depression to a class 1 hurricane," says Fratello. "By the time we left Karl 15 hours later, it was in transition from a stage 2 to a stage 3 hurricane."

All three aircraft arrived at the eye at virtually the same time. Using an Xchat communications system, the scientists aboard the DC-8 and the pilots of the WB-57 were able to communicate directly with the Global Hawk operations center back at Dryden. "The lead scientists directing each airplane were selecting an azimuth to fly through so the pilots could coordinate their turns," he says.

Although the Global Hawk was new to this particular game, it quickly proved itself, says Fratello. "The real impact of our aircraft was illustrated during that flight because after a couple of hours of making continuous passes over Hurricane Karl, the DC-8 and WB-57 had to leave because of their normal fuel constraints." The Global Hawk stayed over the hurricane for another 10 hours, making 20 passes directly over the eye. "That's pretty dramatic and why our aircraft has gotten so much attention within the NASA airborne science community. It's a game changer," he says.

The data sets collected by the GRIP aircraft alone would be invaluable to environmental scientists, but in the case of Hurricane Karl, three additional aircraft from NASA, the U.S. Navy and NOAA also tracked segments of the storm. Fratello says this voluminous data will give scientists plenty to study over the next year.

The instruments selected for the Global Hawk were remote sensors, says Fratello. "We didn't have any in-situ sensors. We weren't measuring the environment near us. All of these sensors were designed to remotely sample and measure the data from above the storm and not go down into it," he says.

The instruments aboard the GRIP planes measured wind speed in horizontal and vertical dimensions, 3-D observations of storm clouds and precipitation structures, and lidar measurements of clouds and aerosols in and around hurricanes.

Although the GRIP instrument packages provided Fratello with several challenges, he says the prior GloPac environmental mission let his team work out any kinks. "GloPac was when we really checked out our payload system," Fratello says. "It's designed to be plug and play. The pallets come in and out, and the hot points are easy to access. By the time of the GRIP missions, the process was going pretty smoothly."



The eye of Hurricane Earl, as seen by the Global Hawk.

However, one instrument package — the High Altitude Imaging Wind and Rain Profiler, or HIWRAP — actually changed the profile of the Global Hawk. The fiberglass fairing that houses the instrument

adds a circular projection to the aircraft's

belly that Fratello and his team had to carefully review. "The Air Force had already done some work on something similar, so they had wind tunnel data on aerodynamic effects." After reviewing that and other data provided by Northrop Grumman, Fratello determined the HIWRAP's impact to be negligible. "There was an impact on endurance, about five percent."

That tradeoff is well worth it for this and any future missions. "It gave us an even larger payload compartment down there," says Fratello. "That fairing has a five-foot circular cutout because HIWRAP needed it. We can put almost anything in there."

The Lightning Instrument Package was the biggest challenge for the Global Hawk team because it required installation of five separate field mills, two on each side of the fuselage and one below the rear tail. "It was a lot of learning," recalls Fratello. "A lot of special panels had to be built to accommodate these special field mills."

Among other Global Hawk improvements for this mission: a fully independent command control system designed specifically for the payloads. "We have six Iridium links and a 48-inch Ku-band dish dedicated entirely to payload communications," Fratello says. "None of them are used to control the aircraft." This system lets scientists talk directly to their instrument packages in real-time without cutting in on the system that lets the Global Hawk pilots do their job.

"We provide instrument owners command of their data using the Iridiums," he says. "With that big 48-inch dish, we're giving scientists a huge wideband link to the ground which they typically don't have."

Fratello recognizes the aircraft must serve his customers as efficiently as possible. "Because the aircraft is a truck, it's in our benefit to make it as flexible arrangement of instruments as we can. We actually have twelve different payload areas in the airplane wired to accommodate customer payloads."

Fratello says the Global Hawk's performance during the GRIP missions was stellar. "I'm an advocate for our customers, and they wanted their systems over the hurricane," he says. "We're not going to risk this airframe, but we're going to give our customers what they want."

NASA has several proposals underway to further hurricane research. One proposal, Hurricane Severe Storm Sentinel, is a five-year program specifically for Global Hawk that is slated to begin in 2012. "We'll be flying the airplane for three consecutive hurricane seasons out of the East Coast," says Fratello. "We're building a remote mobile ground control station and payload base that are shippable. A lot of the same people managing GRIP are responsible. We're looking at over 240 flight hours each season."

Both of NASA Dryden's Global Hawks are scheduled to work this mission. "They won't fly simultaneously, but we'll have the ability to launch the second airplane as the first is coming back. We should be able to have the airplane over a hurricane for as much as 20 hours. There's a lot of interest and excitement about that." Fratello and his team are reviewing and integrating the various scientific payloads.

Clark Perry is a writer living in Los Angeles.

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Regional Overview: Australia

Defense Forces Moving Quickly to Field Herons, Shadows

By Kym Bergmann



Imagery Analyst Leading Seaman Neil Richards monitors Heron's flight imagery from the intelligence control room at Kandahar Airfield in Afghanistan. Photo by Jo D'Amico. All images courtesy Australian Defence Force.

Asked to assess major achievements in 2010, Australia's Chief of the Air Force Mark Binskin placed the Royal Australian Air Force's Heron unmanned aircraft deployment in Afghanistan on the top of his list.

While the initial Heron aircrew was first deployed in 2009, it reached maturity in its operations last year — assisted in its missions by some Australian motion detection software. This is high praise from Binskin given that last year also saw RAAF's first squadron of Super Hornets enter service and good progress on several other projects, including airborne early warning and control.

The Australian motion detection software was developed by the small company Sentient and is marketed under the name Kestrel (for more on Sentient and Kestrel, see the September 2010 issue of *Unmanned Systems*). The software also tracks targets, but its ability to detect small, slow and camouflaged objects appears to make it unique. The developer claims that it can detect targets of less than 2x2 pixels and — in the case of some high-contrast objects — less than a single pixel. These figures were confirmed in missions such as the Australian Heron deployment to Afghanistan, known as Project Nankeen.

Kestrel had its origins within the Defence Science and Technology Organisation and was proven suitable for operational use as a result of a research and development project in 2007. A trained human operator can usually detect a moving object if it has a minimum size of 10x10 pixels — meaning that if a tactical UAV is using a five-

megapixel video camera, the area being monitored can be no larger than a square kilometer. To detect smaller images would mean that the TUAV would have to fly very low, often defeating the point of having it in the first place and also making it more vulnerable to ground fire.

The Kestrel software, using the same parameters, could detect motion within a 20-square-kilometer area. In addition, it is designed to provide the ground station observer with a visual cue: a green square if an object has been tracked for less than two seconds and a red square for anything longer than that. Up to 100 objects can be detected and tracked simultaneously.

Furthermore, Kestrel is independent of camera or platform manufacturer, and it is either in use, or has been trialed on, a number of different airborne systems, including: the AeroVironment Wasp and CyberEye II, the Boeing/Insitu ScanEagle, the RAAF's AP-3C Maritime Patrol Aircraft and, of course, the Israel Aerospace Industries-built Heron. Not wishing to disclose its full customer base, Sentient will only say the company is in dialogue with potential purchasers from the U.S., Israel and Europe. The company is also to be in regular contact with all of the major UAS suppliers and seems to have good links with several of them, including AeroVironment, Northrop Grumman, AAI and Boeing/Insitu.

Project Nankeen, named after a type of nocturnal heron, came about because of an urgent request from Australia's Joint Force Head-

quarters to provide enhanced intelligence, surveillance and reconnaissance (ISR) resources to support troops in the field. Australian involvement is in two main parts — a mentoring and reconstruction task force in Oruzgan province and a Special Forces detachment. The latter, officially known as the Australian Special Operations Task Group (ASOTG), made the request.

While the exact reasons for the request remain opaque, one can infer that Australian troops wanted access to a dedicated surveillance asset that could be prioritized for their needs should such a contingency arise. Until then, Australian Special Forces relied on U.S., Canadian and British hardware for ISTAR support for their operations, and it might have been the case that these assets were not always available. The Australian Heron also provides data for allied forces.

Speed and Success

In contrast to the often glacial pace of Australian defense procurement, the response to the request moved with blinding speed, and by April 2009 various options had been examined and Australia leased an IAI Heron through the Canadian company MacDonald Dettwiler and Associates (MDA). It was at this point that Project Nankeen received its name. It was hardly a coincidence, because MDA already leased a Heron to the Canadian forces in Afghanistan.

The Heron was selected for several reasons, the most important being that it was a theater-level asset — as opposed to a tactical UAS — about the same size as a U.S. Predator and, therefore, more appropriate to the roles and skill sets of the RAAF. Secondly, it was available.

The Canadian connection has been vital in assisting the RAAF learn about large UAS operations as quickly as possible, and it took only 90 days for RAAF personnel to complete their training and be available to support coalition operations. The Australian detachment was collocated with that of the Canadians at Kandahar — anecdotally the world's busiest single runway airfield. Herons are also operated in Afghanistan by France and Germany.

In addition to moving the UAS quickly, Australia also threw high-caliber staff into the mix, transferring crew from aircraft such as F/A-18s, F-111s, C-130s and AP-3Cs to Project Nankeen and establishing an intelligence cell to support the operation. In a highly unusual move, the Heron was deployed directly to the theater of operations without first having been introduced into service in Australia. Apparently the last time this occurred was with Meteor aircraft during the Korean War.

The RAAF refers to its first medium-altitude long-endurance ISR capability as a remotely piloted aircraft (RPA) rather than an unmanned aircraft system — a practice it shares with the U.S. Air Force. Quoting from an internal paper: "Air force stresses that the systems are not robots or drones, but are aeroplanes operated by trained and qualified aircrew, utilising the aviation risk management processes and working to meet airworthiness requirements developed for manned aircraft."

The Heron has proven to be highly reliable, and even though it entered service during the second half of 2010 accumulated 3,500 hours of flight time, with some missions reaching the 20-hour mark. The projection for 2011 is a further 6,500 hours of flight time. While



Air vehicle operator Gunner Greg Armstrong and imagery analyst Cpl. Anthony Norlander assemble a ScanEagle UAV for a mission in Tarin Kot, Afghanistan. Photo by Melanie Schinkel.

the exact sensor configuration is not public information, it carries five separate payloads with some of them in the EO/IR domain.

In the near future, some expected that Australia will commence flight training, initially at the remote Woomera test facility in central Australia.

The use of the Heron is expected to smooth the way for an eventual purchase of a long-endurance, high-altitude UAS that is intended to complement the future fleet of manned P-8A maritime patrol aircraft.

Shadows in Australia

Another major development has been rapid progress on Australia's aim to field AAI Shadow 200s in Afghanistan as soon as possible. Under Project JP 129, Phase II, the country chose in mid-2010 to purchase two Shadow systems, and it is expected that the first of these will be deployed late in 2011. The speed with which events are moving is due in no small part to the generous support of the U.S. Army, which has not only been prepared to give Australia one of its own production slots but also to assist with the training of around 30 ground crew and operators. This process has been helped by the personal involvement of U.S. Chief of the Army Gen. George Casey — something for which the ADF is extremely grateful.

Each system consists of six TUAVs (one is a spare), two ground stations, two launch and recovery systems, communication equipment



Flight Sgt. Barry McCrabb observes an Australian-operated Heron RPV as it taxis down the runway for take off from Kandahar Airfield in Afghanistan. Photo by Jo Dilozenzo.

and vehicles for ground transport. In addition, Australia has purchased six Shadow 200s for attrition and also to allow a full system to remain available even if some of the UAVs are being upgraded, for example with the installation of newer payloads. This should enable Australia to operate essentially the same air vehicle throughout its entire 10-year life-of-type. Australia will procure the ground transport vehicles through a separate acquisition.

Once deployed to Afghanistan, after initially being transported to Australia, the first system will be supported with the assistance of the U.S. Army, making the logistic task relatively easy. At the moment, the Australian army uses leased Boeing/Insitu ScanEagles in support of operations in Oruzgan, and the Shadow 200s will replace these after a short overlap of time. This leaves the future of Insitu Pacific a little unclear, though it remains a possibility that ScanEagles might still find a role in undertaking payload development.

At the moment, the ADF does not need to finalize through-life support arrangements for the Shadows, because the second system will not arrive in Australia until 2013.

The other stages of JP 129 are well into the future, especially Phase III – which has the distant aim of replacing the Shadows a decade from now. Phase IV is also at a relatively early point, and it has the objective of replacing the small “organic” Elbit Skylark UAS — procured as an interim solution — with something more permanent. According to official guidelines, the contract has a value of less than \$100 million with a decision expected in 2013.

Finally, the acquisition of a strategic level UAV, most likely Northrop Grumman’s Global Hawk, is still many years away. Despite its potential to provide timely information for disaster relief or monitor small boats leaving the coast of Indonesia — both topical in Australia at the moment — there appear to be no plans to accelerate procurement. On the present schedule, this will not be before 2018 at the earliest. This is in sharp contrast to the two TUAV systems connected with current operations in Afghanistan.

Kym Bergmann is editor of Asia Pacific Defence Reporter and Defence Review Asia.



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European Defence Agency Pushes Forward on Unmanned Maritime Systems

By Yvonne Headington

The European Defence Agency has created a new funding program for unmanned maritime systems with the goal of having initial capabilities for mine countermeasures, harbor protection and antisubmarine warfare by 2018.

The EDA has created an unmanned maritime Category A program, which means it will serve as an investment fund for financing joint projects. All European Union member states are part of the EDA, except for Denmark, and Category A projects assume that all EDA members will take part unless they specifically opt out.

The EDA confirmed the maritime research and technology efforts at a meeting of its steering board on 9 Dec., 2010.

Each program is subject to a program/technical arrangement, or PA/TA, similar to a memorandum of understanding. Unlike Category A programs, Category B efforts usually involve a smaller number of member states who opt in, and funding is directed to individual projects, each of which requires a PA/TA.

Ten EDA members — Belgium, Finland, France, Germany, Italy, the Netherlands, Poland, Portugal, Spain and Sweden — contribute to the four-year, 53 million euro (\$73 million USD) UMS project. Norway is also involved under an administrative agreement with the EDA.

The main focus is on mine countermeasures capabilities, including minesweeping, detecting drifting mines, and detecting and neutralizing buried mines, but it also includes harbor protection and antisubmarine warfare. EDA expects the program will promote cooperation between navies, national laboratories, universities and industry.

As a Category A program, only one PA/TA covers all the project's elements. After demonstrations and risk-reduction efforts, an initial capability is set for 2018. A EDA spokesperson says, "This initial capacity cannot be disclosed at the moment," but the French research program named Espadon could give some clues.

The Espadon program includes an unmanned surface ship capable of deploying unmanned underwater vehicles. It is being developed by an industry team made up of DCNS, Thales and ECA under a contract from the French procurement office, or DGA.

Air Systems

EDA's work on unmanned aircraft is covered by a number of projects, including the Mid-Air Collision Avoidance System (MIDCAS), a command-and-control link that would join air traffic control and unmanned aircraft via satellite, and UAS engine research efforts.

UAS and related technologies have been identified as critical to the future of the European military aerospace industry, and to this end EDA began work on a future air systems strategy, dubbed FAS4Europe, in September 2010, with an immediate focus on UAS and helicopter capabilities.

According to the EDA, this work will "underpin Europe's ability to satisfy future capability demands from indigenous sources of supply."

EDA is also working to dovetail some of its UAS work with European Commission initiatives such as UAS air traffic management integration. The agency is establishing a UAS program with in the European Framework Cooperation structure, which is designed to promote collaborations with partners such as the EC and the European Space Agency.

The EDA was established in 2004 to support efforts intended to improve European defense capabilities. One key objective is to enhance cooperation on procurement between member states to secure a better return on European defense investment.

However, the agency's somewhat byzantine work structures involve considerably greater management efforts than would be necessary for national research and technology programs.

The bureaucratic burden partly explains the United Kingdom's antipathy toward such cooperation through Brussels, Belgium,



The Espadon research program, the possible future face of European cooperation? Photo courtesy DGA.

home base of the EDA. The U.K. has considered withdrawing from the EDA amid concern that the agency is "not yet delivering the full benefits and improvement goals it has set itself," but the government agreed last December to extend its membership on a provisional basis for two years.

The U.K. did succeed, however, in blocking a proposal to increase the EDA's 30.5 million euro annual budget by 3.8 percent.

As an example of the United Kingdom's preference for bilateral collaboration, the Anglo-French declaration on defense and security cooperation, signed on 2 Nov., 2010, includes an agreement to work on future UAS.

An informal parliamentary working group has been set up to monitor the Anglo-French declaration, with its first meeting taking place in Paris in December 2010. The working group's selected themes for 2011 include cooperation on unmanned systems.

Yvonne Headington is a freelance writer on Defence and Security issues and edits the weekly newsletter Defence News Analysis – A View from London (www.dranda.btinternet.co.uk).

Get Kinected

New Video Game Sensor Takes Off in DIY Robotics Community

By Danielle Lucey

The November 2010 release of the Kinect for Xbox 360 marked not only a turning point in gaming, but opened up new possibilities for robotic engineers at all levels thanks to its open source architecture.

Kinect, once known before its release inside Microsoft as Project Natal, is a controller-free gaming system that interacts with the user via gestures and spoken commands. Using software from Microsoft-owned company Rare and a 3-D tracking range camera from Israel's PrimeSense that uses infrared technology, the system creates a 3-D reconstruction of its immediate environment nearly instantaneously.

This ability plus some ingenious hacking has resulted in so many various applications for Kinect that California company Willow Garage hosted a Kinect hacking contest in January.

Many of these new uses could easily parlay into the unmanned systems community. Here is a brief look at what do-it-yourself engineers are pioneering.

Enhancing Mobility

Conyers, Ga., robotics company GeckoSystems International has created a new software it calls GeckoImager using Microsoft's Kinect sensor. When used in concert with the company's Mobile Robot Solutions for Safety, Security and Service, GeckoSystems was able to retrofit an electric wheelchair to be "collision proof," according to the company.

The way it works is that the person seated, as is typical with electric wheelchairs, would use a small joystick to move around in their environment. When that joystick uses the GeckoImager technology along with other GeckoSystems products GeckoNav and GeckoSavants, the wheelchair would automatically move in the direction commanded while also avoiding all stationary and moving obstacles. GeckoSystems says that two Kinect sensors are necessary to scan a 360-degree area.

The company says a major benefit of using the Kinect sensor is its price. For less than a few hundred dollars, any electric wheelchair could be retrofitted.

Kinect in the Driver's Seat

The University of Bundeswehr Munich in Germany took its Kinect concept to the streets, at least in theory, powering a mini-car through an autonomous drive around a university lab.

The college used the same software that ran on its MuCAR-3 in the DARPA



The University of Bundeswehr Munich's mini autonomous drive car.

Urban Challenge housed inside a notebook computer on a 1:10 scale vehicle to achieve autonomous navigation. The sensor mounted on the front of the miniature car scanned its environment, with the notebook in the back of the car acting as its central brain.

The university, though successful with its Kinect, still plans on making improvements, such as giving the car an accurate odometer to improve its navigation.

In the Operating Room

Graduate students at the University of Washington in Seattle hacked into Xbox's Kinect in hopes of fine-tuning hacking in another department: surgery. While robotic surgery has grown in popularity with the daVinci surgical system, incorporating Kinect into robotic surgery is novel.

The students' method uses the Kinect as a method of feedback when using tools in surgery, a field known as haptics.

"For robotics-assisted surgeries, the surgeon has no sense of touch now," says Howard Chizeck, professor of electrical engineering at the college, in a university press release. "What we're doing is using that sense of touch to give information to the surgeon, like 'You don't want to go here.'"

Typically robotic surgery provides no feedback to the operator, leaving them with no realistic sensation of the procedure they're performing. But electrical engineering student Fredrik Ryden fixed this by writing code that made the Kinect map and react to environments in 3-D. Then it sends that spatial information back to its user, thereby restricting the area of motion of the tool. The effect is that the surgeon receives pushback from the instrument, preventing them from penetrating an off-limits area inside the body.

"We could define basically a force field around, say, a liver," says Chizeck. "If the surgeon got too close, he would run into that force field and it would protect the object he didn't want to cut."

Prior to Kinect's release, the team toyed with using a CT scanner to define regions in a surgery, but the use of a depth-measuring infrared camera won out, in part because of its cost.

"It's really good for demonstration because it's so low cost and because it's really accessible," says Ryden. "You already have drivers, and you can just go in there and grab the data. It's really easy to do fast prototyping because Microsoft's already built everything."



The Kinect for Xbox 360's open source software has allowed users to find new, inventive uses for its gaming sensors. Photo courtesy Xbox.



MIT used iRobot's Create platform to make a gesture-directed robot.

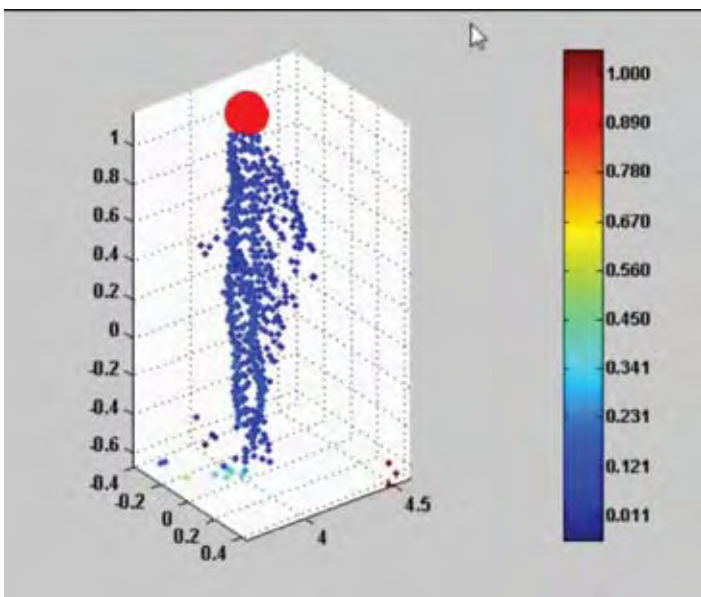
Ryden designed the Kinect surgery system over one weekend. He says he will soon publish a paper on the research. Before it can be used on a wide scale, he says the sensors will need to be scaled down and the resolution of the video must improve.

'Roomba, You Missed a Spot'

A student at the Massachusetts Institute of Technology — a breeding ground for company iRobot that went onto market, among other things, robotic vacuum Roomba — took having your own personal robotic cleaning slave to the next level: adding motion recognition.

While not actually a Roomba, Philipp Robbel from MIT's Personal Robotics Group took the very similar in shape iRobot Create platform and mounted Kinect's infrared sensor to the top, which allows it to recognize human beings and respond to their gestures. Named KinectBot, the system relies on simultaneous localization and mapping, or SLAM, code from OpenSLAM.org and visualization packets from Mobile Robot Programming Toolkit.

Robbel, who has created four separate robots based on Create, which he has dubbed "iPucks," told Singularity Hub that he envisions a future where Kinect-enhanced robots could assist in disaster relief, obeying the commands of the injured while in a swarm formation.



A rendering of how MIT's Kinect sensor images a person.



UC Berkeley's quadcopter controlled by a Kinect won second place in Willow Garage's ROS 3D Contest.

Kinect-ocopter

The Hybrid Systems Lab at the University of California Berkeley replaced a number of sensors on the school's quadcopter and replaced them with the Kinect sensor. Acting as a radar system, the Kinect was able to navigate a room and sense and avoid obstacles. The work, under graduate student Patrick Bouffard, was part of the school's Stanford/Berkeley Testbed of Autonomous Rotorcraft for Multi-Agent Control (STARMAC) project.

Combining it with the open-source software Robot Operating System, Bouffard mounted the Kinect sensor to the four-pound quadrotor. A YouTube video of the copter avoiding obstacles has become an Internet sensation, with more than 800,000 views as of press time.

The work went on to win second place in Willow Garage's ROS 3D Contest.

Kinect Goes Invisible

One of the most mindboggling Kinect hack videos to hit YouTube since its release was "Optical Camouflage Demo With Kinect." Using Kinect's motion tracker in conjunction with C++ toolkit openFrameworks, Japanese coder Takayuki Fukatsu was able to appear as only a fully transparent outline of himself.

While this likely won't be used on the battlefield anytime soon, as Fukatsu would not appear invisible to any camera eye other than Kinect's, it is a shockingly simple solution to invisibility in controlled environments.

Danielle Lucey is managing editor of Unmanned Systems.

Scan the bar codes to see videos.



GeckoSystems



University of Washington



MIT



University of
Bundeswehr Munich



University of California
Berkeley



Camouflage with
Kinect

There's an App for That: Empowering Warfighters With Smartphones and Tablets

By Charles Drutman and Mark Hutcheson

The world is in the midst of a major paradigm shift in computing and connectivity resulting from the availability of low cost, high-power mobile electronic devices.

These devices are — somewhat dismissively — called smart phones and tablets but are actually eminently portable, always-connected computers. Smart phones and tablets are expected to give the warfighter new and highly significant capabilities on the battlefield. Optical Alchemy Inc. (OAI), based in Nashua, N.H., is coupling the capabilities of these highly mobile devices to unmanned vehicle payloads.

In-Air Processing

Historically speaking, it has been very difficult to get data from remote payloads to warfighters. Data is often streamed to only one location where it is then captured and distributed to other nodes in the net-centric system. Because of this architecture, delays in data distribution and command and control response compromise functionality. OAI has addressed this problem by putting all processing in the sensor payload, making each sensor a central distribution point for real-time video and data. The result has been measured video and data latencies under 200 milliseconds, which appear as real time for a human operator.

For more than 10 years, OAI has been developing cutting-edge ultra-light geo-referenced gimbaled sensor payloads for UAS applications. OAI has implemented an Internet protocol (IP)-based system incorporating both command and control functions and video and data streaming. These streams are multicast to all users in the field, as well as to command centers anywhere in the world via the ubiquitous protocol. IP streaming also allows mobile devices at the receiving end to replace larger, more traditional computer systems.

With these two capabilities (in-air processing and the IP-based architecture), OAI's sensor payloads are able to easily integrate and interact with mobile devices in a real-time and fully functional way.

Smart Phone Capabilities

OAI is developing a suite of programs based on the Android operating system and iOS, Apple's operating system, that interacts with its lightweight, georeferenced sensors to give the warfighter these new smart phone capabilities.

OAI is adding several new smart phone-based capabilities to its KJ-640 gimbaled sensor system, including new user interface modalities and the integration of field-generated inputs into a common operating picture.

A major focus of OAI's work on command and control has been to support multiple interaction modalities. For example, Geocam4D supports user interaction through a touch screen, mouse and hand-



A live image stream from OAI's KJ-640 gimbaled sensor is highlighted by having the live transport stream simultaneously displayed on a ruggedized laptop, a Galaxy tablet and a Droid X phone. Photo courtesy OAI.

controller; which one a user selects may depend as much on conditions as on preference. For example, while a user may have a personal preference for the touch screen interface, conditions on the ground (i.e., in a moving truck on a bumpy dirt road) may force them to use a hand-controller as the only means to effectively interact with the KJ-640.

The company has implemented touch screen operations that mimic the common operations that mobile users are familiar with, such as pinch to control zoom. It is also experimenting with additional interface modalities enabled by many mobile devices' internal sensor packages. For example, the three-axis orientation sensors have allowed the company to implement sensor control based upon user motion and orientation. Geoid4D has a follow mode where the sensor tracks the orientation of the user. That is, if the user faces 20 degrees west of north, so does the sensor.

OAI has also demonstrated voice control using built-in speech-to-text libraries. Geoid4D currently supports a limited vocabulary that supports azimuth and zoom control and the KJ-generated metadata sent through text messaging. The company plans to integrate a separate custom GIS (geographic information system) program running on the Galaxy Tab into Geoid4D to allow sensor control based upon touch screen GIS interaction. This will mimic the Geocam4D capability to slew the sensor from a map-based context.

One of the key issues the company has addressed in supporting field operations is the detection of and response to intermittent communication links. From a user perspective, intermittent communications create delays between user-entered command and control functions and visual confirmation. These delays can cause intense user frustration. To alleviate this problem, Optical Alchemy has developed proprietary algorithms to monitor the health of the link and automatically adjust to changing conditions. For example, when the system detects that the link has been compromised, it forces the user into a view-only mode. Aside from preventing user frustration, this

also prevents any possibility that a large number of commands will be stacked and sent in burst mode when the link returns. When the link is weak but still available, the system automatically modifies communication parameters to support as much command and control as possible without overloading the link.

The company has already ported most of this code over to the Droid, so the current implementation of its handheld based system contains a similar level of functionality and robustness to changing link conditions.

All of the capabilities discussed so far have focused on sending data generated from the KJ-640 sensor to users in the field, but mobile devices can also support the dissemination of data generated by users in the field.

The company can extend this capability to allow in-field users to send geo-referenced imagery and, through image processing, determine, for example, the locations of shadow-producing objects. Combining this with an algorithm for enhancing shadowed objects, the system can automatically trigger this algorithm in real time, based upon the sun's position, to highlight objects that might otherwise be missed.

Possibilities

The introduction of what are essentially low-cost mini-computers with multiple sensing modalities has opened a wide range of possibilities for supporting net-centric operations and providing a common operating picture to all echelons of warfighters. While there are dif-

ferences in capability and usability among different manufacturers' devices, there is enough commonality to allow any given device to be mastered relatively quickly. This means minimal training and quick acceptance by users in the field.

The keys to acceptance are robustness of operation and ease of use. For field operations with remote assets, like UAV-based gimbaled sensor payloads, it is therefore critical to respond to changing link conditions so that the user knows what they can and cannot do at any given time. OAI has found that the code it has implemented on a PC translates in large part to mobile devices to create a robust command and control system based on mobile devices.

OAI believes mobile devices will likely find their way into warfighters' hands in increasing numbers as a means to provide a common operating picture in a net-centric environment and will greatly expanded capabilities for ground based troops.

Charles Drutman is vice president of software and algorithm development at Optical Alchemy. His primary responsibilities include the development of ground station software and the exploitation of imagery and data from the KJ class of gimbals in support of our warfighters.

Mark Hutcheson is the director of business development at Optical Alchemy. His responsibilities include understanding warfighter requirements, driving product developments that meet those requirements and developing customer relationships to deliver those solutions to the warfighter.

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All in the Name of Fire Science

Unmanned Aircraft Battle Flames and Smoke During RxCADRE 2011

By Lindsay Voss



RxCADRE at Eglin Air Force Base relied on UAS to convey controlled burn information on up to 2,000 acres a day. All photos courtesy Tom Zajkowski and Mark Bauer, U.S. Forest Service.

Unmanned systems are becoming popular research tools for widespread applications. Unmanned maritime systems are being operated to study the effects of climate change in the world's oceans, unmanned ground vehicles are capturing environmental data in locations unfit for humans and unmanned aircraft systems are compiling information from tornadic thunderstorms. When it comes to research, unmanned systems can get the job done in high winds or arctic temperatures, thousands of feet under water or miles above in the air.

This February, UAS once again became valuable tools for the research community by providing data to scientists studying wildland fire behavior and dynamics as a part of the Prescribed Fire Combustion-Atmospheric Dynamics Research Experiments (RxCADRE) exercise held 4-13 Feb., 2011 at Eglin Air Force Base in northwest Florida. Three different UAS platforms flew during the exercise, including the Maveric UAS, manufactured and operated by Prioria Robotics; a U.S. Forest Service/U.S. Geological Survey Raven A system; and a G2R UAS operated by the 46th Test Wing of Eglin Air Force Base.

RxCADRE is an exercise conducted every two years in conjunction with the U.S. Forest Service and the Eglin Air Force Base Natural Resources Branch commonly known as the Jackson Guard. At these exercises, fire researchers representing agencies and universities from across the country gather to conduct a number of research assessments on controlled burns. The 2008 exercise featured prescribed burns in Florida and Georgia, but this year's exercise was limited to large acreage burn blocks at Eglin.

This is not the first time UAS have been used during a staged wildland fire exercise. Last September, several systems were operated during AUVSI's Firefighting Table Top Exercise 2010 (FF-TTX 10) at Dugway Proving Ground in Utah, including the Prioria Maveric and a Lockheed Martin Stalker system. These aircraft were utilized

to survey a small acreage grassfire and a structural fire to demonstrate how UAS could be integrated into a wildland fire scenario to support incident managers and firefighters on the ground. Unlike FF-TTX 10, where the spotlight was on integrating unmanned systems into firefighting activities to increase public safety, RxCADRE was a much larger exercise focused on studying wildfire behavior and dynamics utilizing various tools including UAS, manned aviation assets and weather analysis instruments.

The Jackson Guard routinely conducts prescribed fires at Eglin, typically burning more than 100,000 acres a year to manage the growth of non-indigenous trees and shrubs that threaten the area's longleaf pine forests and the native wildlife habitat. Unlike the controlled burns conducted during the 2010 TTX exercise at Dugway Proving Ground, the prescribed burns during RxCADRE totaled several thousand acres, averaging approximately 1,600-2,000 acres on days with favorable burn conditions. These large fires allowed researchers to collect information on fire behavior, atmospheric dynamics and fire effects in a controlled setting.

"RxCADRE is the cutting edge of fire measurements," said Kevin Hiers, prescribed fire program manager from the Jackson Guard. "We have leading scientists from around the nation collecting data on the same burn to both test methods and advance our understanding of fire behavior. Studying fire behavior and smoke transport on a prescribed fire allows us to have much more predictable conditions to validate our models."

"By burning at a large scale, the data collected at RxCADRE are at similar scales of western wildfires and push the models to their limits under conditions where validation data are possible," Hiers added.

Major objectives for the 2011 RxCADRE exercise included implementing prescribed burn ignition and contingency actions in a safe

manner to support ecosystem management and fire research objectives, providing a collaborative training environment for the Eglin Fire and Emergency Services team and the Jackson Guard, and evaluating the protocols and functionality of UAS and associated sensor systems in a wildfire environment. From a research perspective, several data points were of interest including pre-burn fuel loads, post burn consumption, ambient weather, in-situ convective dynamics, smoke plume dynamics, radiant heat release, fire behavior and select fire effects. UAS operations were able to assist with several of these data collection objections by providing persistent time on station.

Each unmanned aircraft flew missions one at a time on 30-minute rotations, providing continuous aerial coverage of the fires. The Maveric was equipped with either a short-wave infrared camera (SWIR) or an electro-optical camera for its missions, while the Raven A provided surveillance using an infrared sensor. The G2R was equipped with cameras as well as a carbon sensor and an instrument to determine relative humidity. A video feed from all three UAS was streamed to the Mobile Emergency Operations Center (MEOC) so firefighters and researchers on hand could see the data collection in real time. In addition to the UAS, a manned helicopter carried a delayed aerial ignition device (DAID) to drop ping-pong ball sized spheres filled with potassium permanganate and ethylene glycol to ignite the fire. A manned Cessna aircraft also flew overhead during the exercise with a lidar sensor for mapping.

According to Hiers, the fire research community is enthusiastic about the use of unmanned aircraft as investigative tools for smoke plume sampling and other atmospheric research related to fire. Researchers



This year's RxCADRE used smaller UAS, like this Raven A, but next year, demo planners hope to see larger UAS in the sky, like ScanEagle.

at RxCADRE were positive about the ability of the deployed UAS to constantly measure ignition patterns and fire lines from an orbiting view. The acquisition of atmospheric data within and around the smoke plume, such as temperature, humidity and wind speed, was also valuable. A notable success from the UAS operations included deploying a mini-aethalometer in the nose cone of the G2R platform to collect concentrations of particulate matter in the fire plume. This type of sampling and data collection will assist fire researchers to better understand the impact of fire on the local weather environment, and conversely, the impact the local environment has on wildland fire.

Though the focus of RxCADRE was on fire science, UAS operations went beyond sampling and surveillance. The systems also provided real-time situational awareness that assisted fire managers in predicting and assessing fire behavior during the exercise, increasing overall safety for researchers in the field and attendees in the exercise staging area. For future exercises, unmanned aircraft could be used to maintain researcher accountability, provide further smoke plume analysis, assess fuel loads prior to the burn and monitor lingering hot spots post burn.

Hiers and others in the fire community are already planning for future RxCADRE events by exploring different UAS platforms, sensors and instruments that could be valuable for these research efforts. Operating a larger, long-endurance aircraft such as a ScanEagle above smaller, hand-launched systems is a key priority for the next RxCADRE exercise. There is also interest in collecting wind and temperature data from start to finish across the burn, which can be achieved with a larger UAS system and simultaneous aircraft operations. Longer term unmanned helicopters could be used to transport the DAID fire ignition system, and larger UAS could be brought in to carry lidar sensors and other technologies of interest such as synthetic aperture radar. There is also interest in deploying unmanned ground components in future exercises for applications including search and rescue, fire retardant dispersal, and brush clearance.

Lindsay Voss is senior research analyst for AUVSI.



Request for Information

(Sources Sought)

Unmanned Aerial Systems (UAS) for University Use

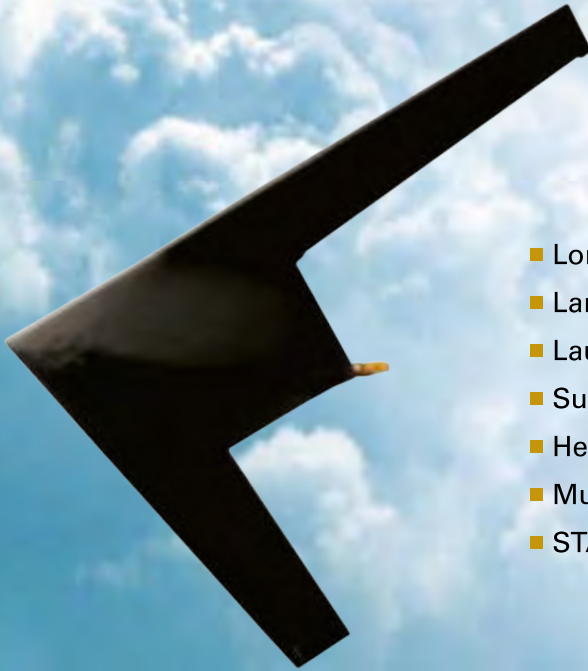
ISR Group is requesting information from interested sources in order to acquire Unmanned Aerial Systems (UAS) to support a prominent University's UAS Program. This program will include Associates, Undergraduate and Graduate studies in UAS Operations, Maintenance, Management, as well as Payloads and will be a requirement in the immediate future.

The primary objective of the UAS is to support University, along with ISR Group related initiatives in:

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DEEP DOWN UNDER

Gliders Explore Flooding Impacts Off Australia's East Coast

By Danielle Lucey

In December and January, Queensland, Australia, was slammed with floods that took 35 lives and cost more than \$30 billion Australian dollars in damages. Major Queensland artery the Brisbane River rose so high that its Wivenhoe Dam, which creates the main water supply for the city Brisbane, nearly reached its flood mitigation capacity.

The flooding affected not only local inhabitants but also the marine life that depends on the river — The Queensland Times even reported that two bull sharks were spotted swimming in Goodna, Australia, by the city's McDonald's.

The floods presented an ecological research opportunity for Australia's national science agency, the Commonwealth Scientific and Industrial Research Organisation. Through CSIRO's Wealth of Oceans Flagship, ocean engineer Andy Steven and his research team deployed an unmanned underwater glider in Moreton Bay, located on the eastern coast of Brisbane, to monitor the extent of the flood plume flowing from the Brisbane River.

"This disastrous flood also provides us with a rare opportunity to understand how our marine ecosystems respond to massive inputs of fresh water and sediments," says Steven in a CSIRO press release. "The glider will generate three-dimensional maps illustrating the impact of the flooding on the marine waters receiving the flow of the Brisbane River."

These maps will be built by coupling the data retrieved from the glider with satellite images.

"CSIRO and its partners in the Queensland government are working closely to get out there and monitor just how far the flood is getting offshore, start to understand some of the impacts in terms of the ecology, is it affecting seagrass, is it affecting corals," says Steven.

CSIRO owns one of only two UUVs in the world with an array of sensors capable of mapping these 3-D underwater images, according to the organization. The glider's sensors will measure light, oxygen, temperature, salinity, nutrients, organic matter and phytoplankton in addition to the mapping data.



An International Space Station astronaut snapped this photograph of the flooding along the Brisbane River in the suburbs of Brisbane. Most of the ground, especially in the upper left, is inundated with brown flood water. Image courtesy NASA.



CSIRO ocean engineers Rob Gregor and Lindsay MacDonald with a Slocum glider, which will survey the environment of Australia's Moreton Bay. Photo courtesy Craig Maculay, CSIRO.

"Satellite images can clearly show the surface patterns of cloudy water and nutrients, but a companion instrument — the glider — is required to provide a sub-surface view," says CSIRO biological oceanographer Peter Thompson.

CSIRO's \$200,000 Australian dollar Slocum Glider, made by Teledyne Webb Research, runs on alkaline batteries that can typically operate for about 30 days, depending on its range. The 21-inch-diameter glider runs down to 200 meters deep, dead reckoning its way to waypoints. It surfaces to send data back to the researchers and to recalculate its location via GPS.

"The glider uses differences density to glide across the water in its sea source through the ocean, and it measures a number of parameters ... along the way. This data is invaluable to give us a three-dimensional perspective of how the bloom is moving across the reef," says Steven.

As of press time, CSIRO had not released any results from its survey work, but Steven offered up possible ecological problems the glider may encounter.

"Well this is in the area of intense speculation," says Steven. "What we expect might to see is, firstly with the high sediment loads, smothering and reducing the light environment that's available to photosynthetic organisms like corals and seagrass. We might also expect to see some knock-on affects because seagrass is so important to dugong and turtle. We may also see once that sediment starts to settle phytoplankton blooms within Moreton Bay. Some of those could potentially lead to harmful algal blooms, but more generally it's just a large phytoplankton bloom."

Dugong, a large marine mammal similar to the manatee, has its primary habitat between Shark Bay in western Australia and Moreton Bay, spanning the Great Barrier Reef. Though found in other places in the Indo-Pacific region, if the seagrass beds it feeds on are threatened by runoff, its survival may be in danger. Hunted in places like Papua New Guinea, the dugong's waste is also an essential nutrient for other aquatic animals.

CSIRO's work in the bay is in collaboration with the Queensland Department of Environment and Resource Management, the Healthy Waterways Partnership and some universities. CSIRO hopes that the research it collects now will be part of an ongoing effort.

"We're also aiming to establish continuous moorings at key locations to provide ongoing measurements of the bay's health," says Steven. "This information will help us understand the dynamics of the flood plume and its likely effects on seagrass, fish, dugong, turtles, coral

and other marine flora and fauna. It will also give an idea to the bay's resilience after this extreme event."

The research consortium plans to conduct a parallel research program in the Fitzroy River-Keppel Bay region, about 700 kilometers north on Australia's east coast, using a similar glider. The mission will be that glider's first major survey.

"We have done routine trials in Tasmanian inshore waters, but the Queensland projects are really what they have been designed for — a complete shallow-water assessment during a significant maritime event."

Danielle Lucey is managing editor of Unmanned Systems.



An animation of CSIRO's coastal glider depicts how it moves through the water column and transmits data back to the researchers. Video courtesy CSIRO.

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The Challenge

A Small Business Perspective on Entering an Unmanned Systems Competition By Paula Brooks

Editor's Note: Teams from the United States, Turkey and Australia were finalists in the first Multi Autonomous Ground-robotic International Challenge 2010 (MAGIC 2010), held in November 2010 and sponsored by Australia's Defence Science and Technology Organisation (DSTO) and the U.S. Army's Research Development and Engineering Command (RDECOM). The challenge was to create ground robots able to operate fully autonomously to reduce operator workload by allowing small robots to be controlled with minimal supervision. The story below is a first-person account of the competition from Team RASR of the U.S., which finished third; in next month's issue we'll take a look at the top two finishers, the University of Michigan and the University of Pennsylvania.

When your company is in the business of autonomy for unmanned systems, does it make sense to enter a contest? Universities routinely enter competitions as an opportunity for hands-on experience for students but what are the advantages for a small business? Robotic Research LLC lead the RASR (Reconnaissance and Autonomy for Small Robots) team for MAGIC 2010. Here we share our experience and reasons for competing — beyond a desire to see kangaroos.

Decision to Try MAGIC

From the first reading of the rules, we knew that the MAGIC 2010 competition would be difficult. It required a coordinated team of autonomous ground robots to search an area, both indoors and outdoors. Simulated IEDs and enemy combatants needed to be “neutralized” without harming non-combatants. Each team had to map a portion of the Adelaide Showgrounds (an area the size of 25 football fields), in 3.5 hours but with only 10 minutes of operator time to enter commands, validate IED detections and all other functions. We knew that fielding a credible team of robots would require a substantial financial investment and long nights and weekends.

On the plus side, the competition would encourage a leap-forward of technology, fuel development of innovative products and provide interaction with major players on two continents. In addition, it seemed like a fun project and we would get to go to Australia. Sleep is overrated — we entered the contest.

Gathering the Team and Resources

The first person on board was friend and colleague Mark Del Giorno, chief scientist at General Dynamics Robotic Systems (GDRS) who also had his own consulting business, Del Services. He is a renowned expert in autonomous ground robotics. He helped to gain support from GDRS for sensor technology. QinetiQ-North America joined



The RASR team with their Talon platforms in Australia.

the team and contributed significant technical and material support, including the loan of eight Talon robots. For communications, Lee Converse of Cedar Creek Defense was a dependable communications expert who knew both defense and unmanned systems requirements. Our university partner was professor Charles Reinholtz of Embry-Riddle Aeronautical University (ERAU). He had been the driving force for autonomous unmanned systems entries in the DARPA challenges when he was at Virginia Tech. Two of his ERAU students joined Robotic Research as interns for the summer and, again, for the competition.

In the fall of 2009, the government received 23 entries from the USA, Canada, Poland, Japan, South Korea, Turkey and Australia. Our team made the first cutoff — the top 12 teams. After a kick-off meeting in December, we were ready to start work. In June, we would face the next down-select.

Making MAGIC

The officers of Robotic Research, Alberto Lacaze and Karl Murphy, wanted our work on MAGIC to result in products for small ground robots. The army uses primarily tracked robots. Thus, we chose QinetiQ-NA Talon over a wheeled platform even though it would be more difficult to automate. As it turned out, our team was the only one to use a tracked vehicle.

We built sensors systems, including: an in-house INS/GPS unit, a 360-degree camera system and a 360 LADAR scanner. This provided maximize coverage to allow for obstacle detection and 3-D mapping. The result of months of hard work was a completely new autonomous system for small robots, including the sensors, power distribution boards, e-stop system, ethernet radios, control computers and the code for running the system. Our systems were mounted on three Talon robots.

All competitors were required to construct a demo site for the June down-select. The June challenges were only a sample of what we would see in November: obstacle detection and avoidance, path planning, map building (2-D and 3-D), and IED detection and neutralization. During the last week of June, the MAGIC committee arrived to review our progress. As the Talons sped through the course, up ramps, around obstacles, over paper, all the while mapping every detail, we felt like proud parents.

An anxious wait ended a few weeks later, when we were notified of our selection as one of the top finalists. Celebration was brief as the pace of work went into an even higher gear as we started building five more team robots.

Competition in Australia

In October, we shipped the robots to Australia. A few engineers arrived early to unpack and check out the equipment. The rest of the team arrived a week before the competition. There was not much sightseeing as the week became a blur of no sleep, massive liters of coffee and endless testing. The competition itself was incredibly difficult. It was an impressive



Two RASR robots with an "object of interest" — a red trash can playing the role of an explosive device.

course, spread-out in sheds, grounds and buildings of the Adelaide Showgrounds. In the end, our RASR Team was awarded third place. Of course we wanted first place, but to put this in perspective, our company of 14 people, using tracked vehicles, was among the top three winners in an international competition, competing against the top universities in the world.

Was it a MAGIC Moment?

Was it worth it? Yes. The competition gave us the opportunity to test our technology on eight Talon vehicles. Our prior research translated to a creation of a slew of new products, including an inexpensive camera system that creates 360-degree images, an after-action visible review system, a navigation system and a complete autonomous mobility system for small robots. Our company goal is to transfer robotic technology for practical use to the warfighter, and this has certainly been accelerated by our participation in this contest.

Paula Brooks is director of business for Robotic Research LLC and the Team RASR business manager. She can be contacted at pbrooks@roboticresearch.com.

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Where We've Been: RPMB

Developmental Sciences' Mini Airship Demonstrated Police Surveillance Capability

By Brett Davis

Police forces around the world are becoming more interested in using unmanned aircraft for their work. In the United States, law enforcement agencies from Colorado to Texas to Florida are using systems or are working toward doing so. Police in the United Kingdom have also conducted surveillance using small unmanned aircraft.

While the latest effort is new — and may result in an agreement between the U.S. Department of Justice and the Federal Aviation Administration regarding the use of such small systems — it's not the first time such an approach has been tried and shown to be successful.

In the late 1970s, a small company named Developmental Sciences, based in City of Industry, Calif., gave a hand to a nearby police department having trouble with fights after football games.

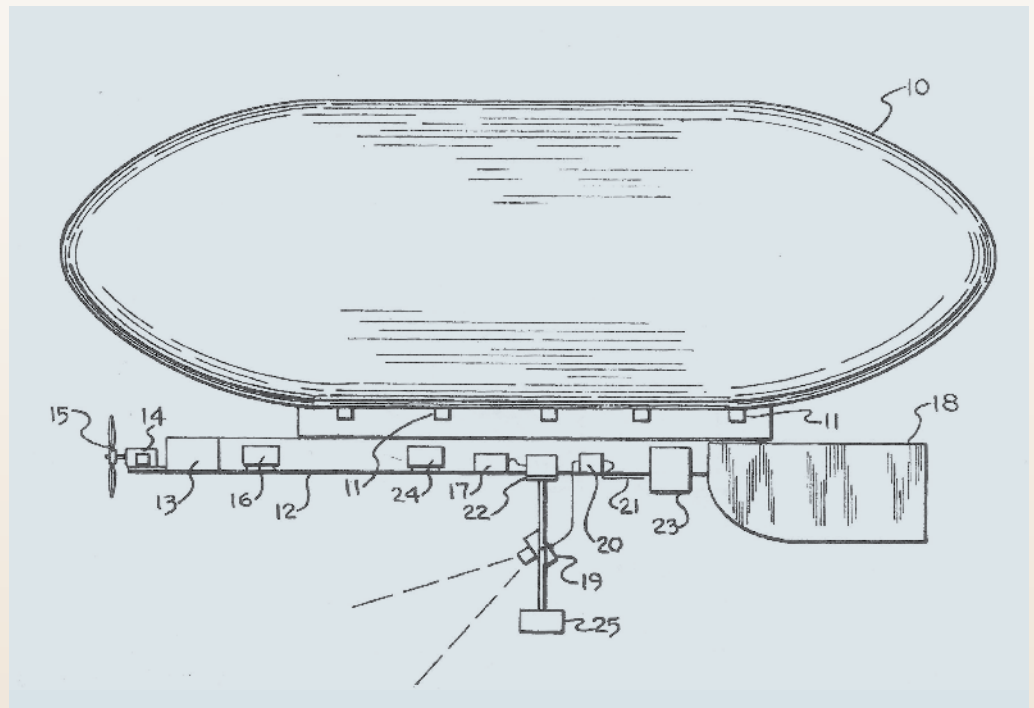
Gerry Sayer, the company's founder — and a former AUVSI president — says he began making presentations to police in the late 1970s, urging them to use small unmanned aircraft to oversee traffic on the L.A. freeway.

"What happened was, through the association of the City of Industry, the Monterey Park police chief came to one of the meetings and I gave a presentation on unmanned airplanes, which in those times people didn't know what they were and it was very new," Sayer says. "He came up to me afterwards and said, 'We have a problem in our city, do you think you could help?' Well, I knew a fixed-wing wasn't going to start at all, but I said we are working on this unmanned lighter than air, maybe it would be."

No Fighting

Monterey Park was a small city that had a football stadium located in the middle of a park. The park had a ring road but no roads leading into the football stadium. After football games there would sometimes be fights and other incidents, but the police couldn't get into the area fast enough to apprehend the perpetrators.

Developmental Sciences had created a small airship using a bag built



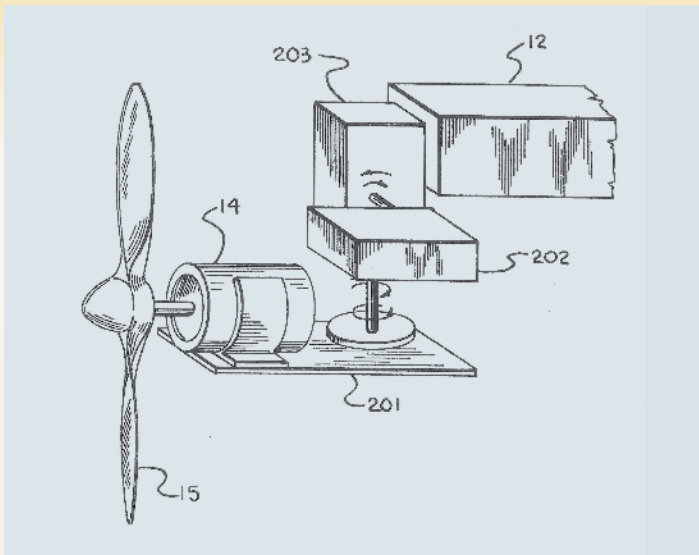
An overview of Developmental Sciences' Remotely Piloted Mini-Blimp. All images courtesy Developmental Sciences.

by a company in Wisconsin. The vehicle, dubbed the Remotely Piloted Mini-Blimp (RPMB) was about 20 feet long and around four to five feet in diameter. Developmental Sciences added a small engine on a mount, which could be moved up and down for pitch and side to side for yaw.

The company filed for a patent on the aircraft's control system, saying it provided a lightweight, relatively simple way to fly a mini blimp without resorting to using complicated, cumbersome systems adapted from airplanes. "Applicant's novel improvements to airship control will minimize size and weight," the filing says. "It will help to provide a practical mini blimp."

There were a few other modifications made for police use. "We put a small TV [camera] on it, we had one of the first low-light level TVs, and then we had a loudspeaker on it," Sayer said. "So they [the police] could see what was happening [and] could video record it." The police could use the loudspeaker to warn potential troublemakers that they were being watched from above.

The company went to the western region of the Federal Aviation Administration for permission, and "Of course, having the Monterey Park Police backing this obviously helped us," Sayer says. It also



The RPMB's simple, lightweight control mechanism.

didn't hurt that the airship was lightly pressurized so even if it were to get shot it would come down slowly, and even if it hit someone "It would be like a marshmallow hitting you." The FAA said yes.

"We flew it, and we got some data," Sayer says. "There were some fights."

The evidence captured by the RPMB even made it into court, providing at least one "Law & Order" worthy moment.

"One case they told me was funny was this young teenager. They're all cocky, 'Not me, man. I wasn't there, I had nothing to do with it, I was home babysitting.' Well, then the judge says, wait just a minute, and he has a little screen or whatever. ... He ended up showing this picture, and we were able to zoom in, and the judge was sitting here and turned around and looked at him ... and said, 'God, that looks like you,' and this kid was so shocked."

Developmental Sciences and the Monterey Park Police flew the RPMB over a few weekends and while the program was successful, at least in terms of showing that police could use unmanned systems to try to curb crime, funding for more flying proved hard to come by, and police use of such systems remains a rarity to today.

"My company, we were ahead of our time, we did all these unmanned systems things, and the public wasn't ready, the government wasn't ready," Sayer says. RMPB "was one of those things that was good, it was there, it could have gone a lot of different ways, it was just too early and, you know, the Monterey Park Police chief was ahead of his time. He had trouble with his city council" over funding, and the RPMB ceased its patrols over the park.

As for the vehicle itself, "We kept it at our place for a while, and after a while I think we just finally gave it away," Sayer says. The company discussed uses of it with oil companies that needed pipeline inspection and those wanting to track animal migration, but in the end, "It just didn't happen."

Brett Davis is editor of Unmanned Systems.



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CHAPTER NEWS

Pathfinder Chapter Huntsville, Ala., USA

The Advanced Science and Technology Directorate (ASTD) of the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC) will host the International Micro Air Vehicle Conference and Flight Competition at Redstone Arsenal, Ala., on 23-27 May.

IMAV partners include Calhoun Community College and the Robotic Technology Park. AUVSI's Pathfinder Chapter, based in Huntsville, Ala., will support the event.

The annual IMAV conference and flight competition event serves as a platform to exchange information on the state of the art in micro air vehicles. Although its members include military and government participants, the primary focus of the conference and flight competition is academia. The German Institute of Navigation (Deutsche Gesellschaft für Ortung und Navigation e.V.) is the overall sponsor of IMAV and invites members from science, industry, military, government agencies and users to participate.

This conference and flight competition has been held for several years, primarily in Europe but also in the United States. The

event was hosted by Eglin Air Force Base, Fla., in 2009, which established the United States as a more permanent partner, and this year's IMAV 2011 will continue to build that partnership. The event was last hosted by Peter Vorsmann in Braunschweig, Germany, in July 2010. Virginia "Suzy" Young, director of the ASTD, was the keynote speaker.

The committee includes some of the top aerospace researchers in Europe, Asia and the United States, and the event is focused upon the development of autonomous controls for very small unmanned aircraft. There are four standard events in the flight competitions, including a flight dynamics and autonomous event in both the indoor and outdoor flight competitions. The spring IMAV 2011 event will add significant rewards for autonomous operations with remote control or video (flying by payload video) control.

IMAV Information

The professional sessions and indoor flight competition will be held at the Robotics Technology Park, located adjacent to the Calhoun Community College main campus in Decatur, Ala. This facility, approximately 20 miles west of Huntsville, was developed to establish Calhoun Community College as the U.S. leader in robotics developmental

efforts. This state-of-the-art facility houses meeting and presentation areas, a ground robotics demonstration and test track, as well as the latest innovations in robotics equipment. The facility also has multiple bay and work/teaching areas, providing each competing team a dedicated work area to prepare for the flight competition.

The outdoor flight competition will be held at Redstone Arsenal in Huntsville. Redstone Arsenal is also the home of the U.S. Army's Program Executive Office for Aviation, the Program Executive Office for Missiles and Space, and the Redstone Technical Center, which is a subordinate organization of the Army's Test and Evaluation Command. Redstone Arsenal has significant test areas that will provide the opportunity for each competing team to demonstrate their systems capabilities. Test Area 6 provides the ability to fly each system in a dedicated environment, while simultaneously providing teams segregated areas for competition preparation.

The professional sessions portion of the conference will feature presentation on selected papers on guidance, navigation and control; sensors, fuselage and propulsion systems; aerodynamics; MAV operations; and systems engineering.

For additional information, please visit the IMAV website, www.springimav2011.org.

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